**UNIVERSITY SENATE ROUTING LOG**

**Proposal Title:** Biosynthesis of Natural Products  
**Name/email/phone for proposal contact:** David Watt, dwatt@uky.edu, 7-3945

**Instruction:** To facilitate the processing of this proposal please identify the groups or individuals reviewing the proposal, identify a contact person for each entry, provide the consequences of the review (specifically, approval, rejection, no decision and vote outcome, if any) and please attach a copy of any report or memorandum developed with comments on this proposal.

<table>
<thead>
<tr>
<th>Reviewed by: (Chairs, Directors, Faculty Groups, Faculty Councils, Committees, etc)</th>
<th>Contact person Name (phone/email)</th>
<th>Consequences of Review</th>
<th>Date of Proposal Review</th>
<th>Review Summary Attached? (yes or no)</th>
</tr>
</thead>
</table>
| Department of Molecular and Cellular Biochemistry Faculty | Dr Louis B Hersh  
3.5549  
lhersh@uky.edu | Approved | 06-18-2007 | Yes |
| Curriculum Committee | L. Derren Sennings  
7-5350  
edi@uky.edu | Approved | 8-6-07 | No |
| Faculty Council | Jennifer Breuer-Kuehne  
3-3750  
jbreuer@uky.edu | Approved | 8-31-07 | No |
| Dean | Jay Peirce  
3-6382  
jpeirce@uky.edu | Approved | 9-10-07 | No |
APPLICATION FOR NEW COURSE

1. Submitted by College of Medicine ___________________________ Date 04-30-2007

Department/Division offering course Department of Molecular and Cellular Biochemistry ___________________________

2. Proposed designation and Bulletin description of this course

a. Prefix and Number BCH 620

b. Title* Biosynthesis of Natural Products

*NOTE: If the title is longer than 24 characters (including spaces), write a sensible title (not exceeding 24 characters) for use on transcripts Biosyn of Natural Prod

c. Lecture/Discussion hours per week 3.0

d. Laboratory hours per week 0.0

e. Studio hours per week 0.0

f. Credits 3.0

g. Course description

An overview of the biochemical pathways leading to compounds called natural products/
secondary metabolites

h. Prerequisites (if any)

Two semesters of organic chemistry

i. May be repeated to a maximum of N/A

(If applicable)

4. To be cross-listed as

PHR 620

PLS 620

Prefix and Number

PHR: ___________________________ Signature, Chairman, cross-listing department

PLS: ___________________________

5. Effective Date Fall 2008 (semester and year)

6. Course to be offered ✔ Fall ☐ Spring ☐ Summer

7. Will the course be offered each year? (Explain if not annually)

✓ Yes ☐ No

N/A

8. Why is this course needed?

To introduce graduate students to the source of natural products, many of which are used as pharmaceuticals

9. a. By whom will the course be taught? Watt (Medicine), Rohr and Crooks (Pharmacy), Chappell (Agriculture)

b. Are facilities for teaching the course now available?

If not, what plans have been made for providing them?

✓ Yes ☐ No

N/A
APPLICATION FOR NEW COURSE

10. What enrollment may be reasonably anticipated? 10 students/year

11. Will this course serve students in the Department primarily? 
   Yes ☑ No 
   Will it be of service to a significant number of students outside the Department? 
   Yes ☑ No 
   Students principally in pharmacy, agricultural sciences, and medical sciences will take this course.

12. Will the course serve as a University Studies Program course? 
   Yes ☐ No 
   If yes, under what Area? N/A

13. Check the category most applicable to this course:
   ☑ traditional; offered in corresponding departments elsewhere;
   ☐ relatively new, now being widely established
   ☐ not yet to be found in many (or any) other universities

14. Is this course applicable to the requirements for at least one degree or certificate at the University of Kentucky? 
   Yes ☑ No

15. Is this course part of a proposed new program? 
   Yes ☐ No
   If yes, which? N/A

16. Will adding this course change the degree requirements in one or more programs? 
   Yes ☑ No
   If yes, explain the change(s) below (NOTE – If “yes,” a program change form must also be submitted.)
   N/A

17. Attach a list of the major teaching objectives of the proposed course and outline and/or reference list to be used.

18. If the course is 400G or 500 level, include syllabi or course statement showing differentiation for undergraduate and graduate students in assignments, grading criteria, and grading scales. ☐ Check here if 400G-500.

19. Within the Department, who should be contacted for further information about the proposed course?
   Name: David Watt
   Phone Extension: 73945
APPLICATION FOR NEW COURSE

Signatures of Approval:

06-18-2007

Date of Approval by Department Faculty

Date of Approval by College Faculty

*Date of Approval by Undergraduate Council Curriculum Committee

*Date of Approval by Graduate Council

*Date of Approval by Health Care Colleges Council (HCCC)

*Date of Approval by Senate Council

*Date of Approval by University Senate

*If applicable, as provided by the Rules of the University Senate

Reported by Department Chair

Reported by College Dean

Reported by Undergraduate Council Chair

Reported by HCCC Chair

Reported by Senate Council Office

Reported by Senate Council Office

Rev 7/06
Course Description
Biosynthesis of Natural Products
PHR620
(PHR760-011; BCH780-001; PLS697-002 for the Fall 2007 semester)

Last revised 10-17-07

Course objectives: Apart from the four general classes of biomolecules that appear in living systems, plants and microorganisms produce molecules unique to a particular species. These compounds, called “natural products”, possess a dazzling array of biological activities that are the basis for diverse industries ranging from fragrances to pharmaceuticals. For example,

- The widely used antibiotic, erythromycin, is produced from a strain of the actinomycete bacteria, Saccharopolyspora erythraea.
- The skin and certain internal organs of many “puffer” fish in the Tetraodontidae family contain tetrodotoxin, an alkaloid that is highly toxic to humans. Nevertheless, these fish are considered a delicacy in both Japan and Korea.
- Resveratrol is found in the skin of red grapes and is a constituent of red wine and is implicated in the “French paradox”: coronary heart disease is relatively low in southern France despite high dietary intake of saturated fats.

Students who take this course will be able to recognize the family to which a newly discovered natural product belongs and predict the likely source materials and pathways that gives rise to this natural product. Specifically, students will understand the shikimate, polyketide, mevalonate, and alkaloid pathways.

Course description: This course, entitled “Biosynthesis of Natural Products,” is designed for graduate students in chemistry, biochemistry and pharmacy. Introductory general chemistry, organic chemistry, and biochemistry courses are prerequisites for enrollment. Undergraduates may enroll in this course with the permission of the course director. This course will introduce students to the general families of secondary metabolites, typically called “natural products” and their biosynthesis as well as techniques used to study these compounds.
Course Director: A course director will be selected among Jurgen Rohr, Peter Crooks, Joseph Chappell and David Watt for a two-year term. The initial course director is David Watt.

David Watt  
Department of Molecular and Cellular Biochemistry  
Biomedical Biological Science Research Building, Room B181  
telephone: 257-3945  
email: dwatt@uky.edu

Class meeting: The course will meet on Monday and Wednesday at 10:00 AM to 11:30 AM in Room 206 of the College of Pharmacy Building. Students are urged to attend class. The lectures will highlight important concepts covered in the textbook and emphasize the material that will be covered on the examinations.

Office Hours: Tuesday, 3:00-5:00 PM, Biomedical Biological Science Research Building, Room B181. Access to this building can be somewhat problematic. You are advised to come across the bridge on Limestone that leads into this building. If you are unable to gain access through the double-doors that lead into the building, please call D. Watt at 257-3945 from the telephone outside the security door.


Blackboard: Copies of lecture notes will be posted on a BB site. Students should print copies of the slides and bring them to class. Students will need to get an account in order to gain access to this site. Only students registered in the course will be able to access these materials.

Examinations: Students will take three examinations. Two examinations (each of which is 90 minutes in length) will be administered during class periods designed in the syllabus and listed below. A comprehensive final examination (120 minutes in length) will be administered at the end of the course. For the Fall 2007 semester, these dates are as follows:

Examination 1, Monday, October 8 from 10:00-11:30AM  
Examination 2, Monday, November 5 from 10:00-11:30AM  
Final examination, Wednesday, December 12 from 8:00-10:00AM

"Make up" Examinations: Students who miss an hour examination for whatever reason will be tested on the material covered in that section of the course on the final examination. The final examination will serve as the "make up" examination. That is, if a student missed the first hour exam and received grades of 85, and 70 on the second, and final examinations, respectively, the
student’s overall performance in the course would be determined by grades of 70 (final examination also counting as the first examination), 85 (second hour examination), and 70 (final examination).

**Auditors:** Students who wish to audit this course should see the instructor.

**Grading:** Grades will be determined on the basis of two hour examinations, and a comprehensive final examination.

Each of the hour examinations and the final examination will be worth 100 points. Students who fail to take an hour examination, for whatever reason, will have the final examination count more toward their final grade. That is, if a student missed the first hour exam and received grades of 85, and 70 on the second and final examinations, respectively, the student’s overall performance in the course would be determined by grades of 70 (final examination also counting as the first examination), 85 (second hour examination), and 70 (final examination). Students are strongly encouraged to take all of the hour examinations. Students must take the final examination to receive a grade in this course.

Standards will be used to convert these overall numerical scores into letter grades: 90-100% is an A; 80-89% is a B; 70-79% is a C; and scores less than 70% are an E. These standards may be adjusted downward if this works to the students’ benefit.

**Regrading examinations:** Students who believe that a mistake was made in the grading of an hour examination should re-submit the examination and a signed note that describes briefly which problem they want to have re-graded to the course director. Requests for re-grading of a particular hour examination must be submitted before the next hour examination. The examinations will be re-evaluated and returned with the subsequent hour examination. Students should be aware that a random number of examinations will be copied prior to returning them to the class.

**Cheating:** No form of cheating will be tolerated. Students are encouraged to read the Student Rights and Responsibilities with regard to cheating and plagiarism (http://www.uky.edu/StudentAffairs/Code/part2-6.html)
Course Topics
Biosynthesis of Natural Products
Last revised 4-30-07

INITIAL OFFERING IN FALL 2007 WILL BE AS PHR760-011, BCH780-001 and PLS697-002

Introduction (3 lectures; Watt)
Primary and secondary metabolites: definitions
Historical context
Principal pathways
  Biochemistry: an overview
  Key players in "secondary metabolism": acetyl CoA, shikimate, \( \gamma,\gamma' \)-dimethallyl pyrophosphate, and amino acids
Brief overview of botanical classification
Conventions for writing mechanisms for organic chemical reactions
An overview of stereoisomerism: general understanding of the terms stereogenic centers, enantiomers, diastereomers, meso compounds, epimers and anomers
  Fisher projections
  R/S, D/L, d/l and (+)/(-) conventions
Conformational analysis: Haworth projections, chairs, envelopes

Carbohydrates (4 lectures; Rohr)
Glucose: structure and biosynthesis
  Brief review of photosynthesis
  Brief review of glycolysis/gluconeogenesis, the citric acid cycle and the glucose shunt (C_5 carbohydrates)
  Deoxysugar and aminosugar biosynthesis
  Other monosaccharides
  Polysaccharides

Shikimate pathways (6 lectures; Watt)
  Biosynthesis of shikimic acid and aromatic amino acids
  Redox reactions in biosynthesis: hydroxylation, peroxidation and epoxidation as recurring themes
  Phe-derived natural products
    Cinnamic and benzoic acids
    Coumarins
    Quinones
    Lignins

Polyketide pathways (6 lectures; Rohr)
  Fatty acid anabolism/catabolism
  Even and odd-numbered chains
  Unsaturated fatty acids
Polyketides: Type 1 (erythromycin), type 2 (anthraquinones and tetracyclins), type 3 (chalcones, stilbenes)
Oxidative coupling of phenols: biphenyls and diphenyl ethers
Further modifications of carbon skeletons

Mevalonate pathways (10 lectures; Chappell)
Mevalonate biosynthesis
Biosynthesis of acyclic isoprenoids
Monoterpenes
Sesquiterpenes
Diterpenes
Steroids
Higher-order terpenes

Alkaloids and amino-acid derived natural products (10 lectures; Crooks)
Biosynthesis of amino acids (an overview)
Natural products derived from Ser and Cys
Natural products derived from Val, Leu and Ile
Natural products derived from aromatic amino acids
β-lactam biosynthesis
Alkaloids derived from ornithine and lysine
Alkaloids derived from aromatic amino acids and anthranilic acid
Pyrimidines, purines and pteridines
Pyrroles and porphyrins
Corrins
# Syllabus for Fall 2007
**PHR760-011, BCH780-001 and PLS697-002**

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<td>2</td>
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<td>27-Aug</td>
<td>Ch 1 and 2</td>
<td>Introduction</td>
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<td>29</td>
<td>W</td>
<td>5-Dec</td>
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*syllabus-fall-2007.doc last revised 3-26-07*
2. New Course Offering – David Watt

Dr. Watt announced his desire to launch a new course, Biosynthesis of Natural Products, (BCH 620, PHR 620, PLS 620), to be developed in conjunction with Plant Sciences and Pharmaceutical Sciences. The faculty unanimously approved the proposal. For the initial offering of this course in the Fall 2007 semester, it will be administered as PHR760-011, BCH780-001, and PLS697-002.